R-2000

SUPER ENERGY EFFICIENT HOME PROGRAM

TECHNICAL REPORT

Canada

Results of the R-2000 Homeowner Survey

031 - PE

PREPARED FOR THE R-2000 HOME PROGRAM

A PROJECT OF THE

ENERGY CONSERVATION BRANCH
ENERGY, MINES AND RESOURCES CANADA

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THE R-2000 HOME PROGRAM TECHNICAL REPORT SERIES

The R-2000 Home Program assists in the ongoing development of the various technologies required to build and operate R-2000 homes. This includes support for standards development and the provision of technical information and resources to the building industry. In addition, R-2000 homes and a control group of conventional homes are being monitored over a two to five year period to gather information on construction techniques, the performance of heating and ventilating systems, indoor air quality and energy consumption. The demographic profile and attitudes of R-2000 homeowners are also being surveyed.

This publication is one of a series of reports documenting technical developments and monitoring activities supported by the R-2000 Home Program and the Canadian housing industry. The program's objective is to assist the housing industry to develop the capability to construct and market quality housing that is both energy efficient and cost-effective.

For further information on the R-2000 Home Program in general, the series of technical reports, or to obtain additional copies of this document, please contact:

The R-2000 Home Program
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1.0 INTRODUCTION

1.1 The R-2000 Program

The R-2000 Program is a joint initiative between Energy, Mines and Resources Canada and the Canadian Home Builders' Association. The Program is designed to improve the quality and energy-efficiency of Canadian housing. More specifically, its purpose is to promote the development and building of safe, comfortable, and energy-efficient housing at an affordable price.

To promote the implementation of technologies which meet this goal, Energy, Mines and Resources Canada has undertaken a number of initiatives. These include: the definition of detailed technical criteria for R-2000 houses; intensive efforts in builder training; research; demonstration and information transfer. All of these initiatives assist in the acceptance or enhancement of energy-efficient housing construction technology.

The five key characteristics of an R-2000 Home are: increased insulation, an air tight envelope, high-efficiency heating equipment, a mechanical ventilation system and good use of passive solar design.

R-2000 homes are marketed as high-quality, energy-efficient and comfortable homes. Energy, Mines and Resources Canada has undertaken an intensive monitoring program to ensure these claims are valid. Information has been obtained through measurement of the performance of the heating and ventilating systems and through the documentation of the perceptions of R-2000 homeowners.

1.2 The Homeowner Surveys

Energy, Mines and Resources Canada has undertaken extensive monitoring of R-2000 houses across Canada. This monitoring included a homeowner survey and follow-up survey. The purposes of these surveys were to:

- determine the effectiveness of the R-2000 technical specifications;
- demonstrate energy savings;
- provide information on indoor air quality and heat recovery ventilator (HRV) performance;
- identify areas requiring improvement;
- assess occupant satisfaction; and
- obtain marketing information on occupants.

The homeowner survey was produced in two versions. The initial survey examined the original 300 demonstration homes and represented the home builder's first attempt at working with the new R-2000 standard. These "demo" homes were also referred to as the "Phase 1" homes. Surveys of these homes were undertaken primarily between 1983 and 1984. The second homeowner survey, "Phase 2", included R-2000 homes built under revised technical criteria. These surveys were carried out between 1985 and 1987.

1.3 Survey Highlights

WHO BOUGHT R-2000?

- the homeowner was predominantly between the age of 31 to 45 years
- almost one-half of the homes had two adults and children, while one-third of the homes were occupied by childless couples
- the majority of homeowners were employed as "professionals"
- 57% of the households had two income earners
- most homeowners previously owned a detached home

WHAT INFLUENCED THE HOMEOWNER'S DECISION TO BUY R-2000?

- information provided by the builder
- the national average cost of the homes (excluding the land) was $103,000
- the ability to customize the home
- size/design and location were two important factors
- homeowners were willing to pay extra for energy-efficient features
- for owners of resold homes, resale value was the most important purchase factor

WHAT ARE THE HOMEOWNERS' PERCEPTIONS AFTER LIVING IN AN R-2000 HOME?

- the majority of homeowners considered the energy features to be positive characteristics, and felt that energy savings were being attained
- the three most important advantages to living in an R-2000 house were: fresh air, quiet and no drafts
- almost one-half of the homeowners perceived no disadvantage to living in their homes
- the most commonly reported disadvantages were HRV noise, dry air and high electrical costs
- the principal indoor air quality problem was dry air in the winter (identified by <10%)
- relatively few homeowners (<15%) specified any air quality problems

HOW DID THE HOMEOWNER OPERATE THE AIR DISTRIBUTION SYSTEM?

- more than 90% of the homeowners operated their HRVs continuously during the winter

OVERALL SATISFACTION WITH THE HOME

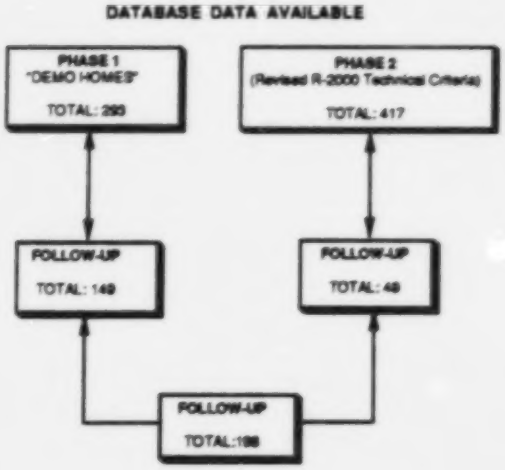
- more than 80% of the homeowners responded that they would purchase an R-2000 home again, while less than 7% indicated that they would not

2.0 DATA ANALYSIS PROCEDURE

2.1 Description of Homeowner Survey Database

The Homeowner Survey

Responses from owners of a total of 710 houses were available for analysis (refer to the figure below), including 293 Phase 1 homes and 417 Phase 2 homes. The contents of the homeowner survey (Phase 1 or 2) could be viewed as "the homeowner's perception of the home soon after moving in".



This analysis concentrated on Phase 2 homes due to the significantly large sample size.

In some cases, surveys were done for the same house under both versions of the survey (a total of 62 houses). In 44 of these homes, there was a new homeowner at the time of the Phase 2 survey. This sample represented the "resold" homes analyzed in Section 3.3.3.

The Follow-Up Survey

Follow-up surveys from a total of 198 homes were available for analysis. Of the follow-up surveys, 49 matched a Phase 2 homeowner survey and 149 matched a Phase 1 homeowner survey. The follow-up survey could be viewed as "the experienced homeowner's perception of the home, having lived in the house for an extended period of time" (usually at least one year).

Data from the follow-up survey was analyzed in two ways. The primary analysis used responses from the complete sample of 198 houses. Initially, the survey results were considered as an "independent" survey, outlining the overall attitudes of the homeowner after at least one year of occupancy. The second analysis involved a direct "one-on-one" comparison, examining the actual change in each homeowner response. Due to the much larger sample size available for the matching of surveys, most of these direct comparisons were done with the Phase 1 survey.

2.2 Overview of Survey Questions Analyzed

The results of the homeowner surveys provide insight into who buys R-2000 homes and why. The following sections graphically illustrate the demographics of the respondents in the survey and their responses to a variety of survey questions. The purpose was to present homeowner impressions after a period of occupancy, and to identify common concerns and common areas of satisfaction.

In most cases, the graphs in Section 3.0 reflect the response to a single question in the appropriate survey. For some graphs, however, the results from different questions were grouped together to obtain a new perspective. To gain further insight as well, it was useful to display the change in responses to a particular question after a period of time. In order to observe how perceptions changed over time with respect to indoor air quality, noise and energy consumption, responses from the homeowner survey were compared to the responses of the follow-up survey.

The adjoining chart lists the various questions addressed in Section 3.0 and highlights the data presented for each question. Section 4.0 briefly examines the general satisfaction of R-2000 homeowners with their homes.

BREAKDOWN OF GRAPHS OF SURVEY RESULTS

Location of Houses in the Survey
- Regional Breakdown
- Provincial Breakdown

Profile of R-2000 Home-Buyer
- Age of Occupant
- Occupation of Occupant
- Occupation of Spouse
- Number of Adults with Children
- Previous Residence
- Own or Rent Previous Residence

Factors Influencing Purchase Decision
- Information Source
- Friends
- Important Purchase Factors
- Custom Home
- Price of Home
- Paying for Energy Features
- Payback on Energy Features

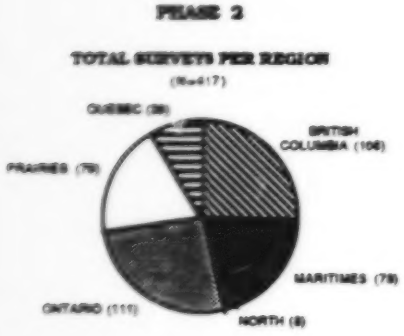
Homeowner Perceptions After Living in an R-2000 Home
- Overall Satisfaction
- General Advantages
- General Disadvantages
- Noise: Relationship to Type of Air Distribution System
- Indoor Air Quality: Foremost Problems
- Indoor Air Quality: Perceived Humidity, Odour, Dry Air Problems
- Energy: How does owner view energy features?
- Energy: Are energy savings being attained?

Homeowner Operation the Air Distribution System
- HRV operation
- Furnace fan operation

3.0 SURVEY RESULTS

3.1 Location of Houses in the Survey

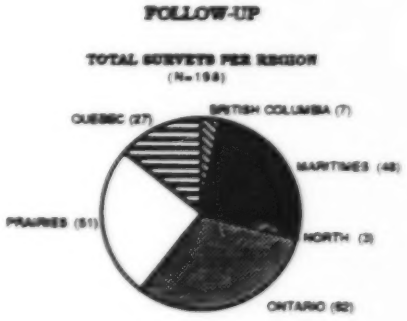
The responses to the homeowner survey were from R-2000 homes across Canada. For the purposes of this study, the responses were grouped into six regions. The smallest region was the North with only eight surveys. The sample size of the Northern region was statistically too small to warrant meaningful analysis. For some of the regional breakdowns, this region was not included.



The regional breakdown of Phase 2 surveys for regions including more than one province were:

- Prairies: Alberta (41)
  Manitoba (20)
  Saskatchewan (18)
- Maritimes: New Brunswick (32)
  Newfoundland (17)
  Nova Scotia (27)
  P.E.I. (2)

The follow-up survey results presented an interesting shift in the distribution of responses. In British Columbia, the number of follow-up surveys was only 3.5% of the total compared to 25% of the Phase 2 survey. If this British Columbian anomaly was ignored, the distribution of responses was consistent between the Phase 2 homeowner survey and the follow-up survey.



3.2 Profile of the R-2000 Home-Buyer

Age of Occupant

The predominant age group of the surveyed R-2000 homeowners was 31 to 45 years (note graphs on page 7).

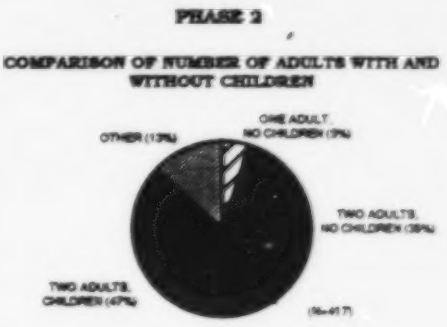
British Columbia had the lowest percentage of respondents in that category (approximately 50%) and a significant weighting in the older age groups. More than 40% of the respondents were over 46 years old and approximately 20% were over 60. This factor appears to correlate with the high percentage of British Columbians reporting "retired" as an occupation.

The Maritimes exhibited the opposite distribution. Few respondents were in the older age categories and the majority fell into the younger age groups.

It is important to note the distinction of the term occupant as used in the questionnaire. Occupant refers to the person to whom the questionnaire was directed. The respondent was not necessarily the "head of the household" and such a classification was not made.

Family Composition

About half (47%) of the R-2000 homeowners lived in a "typical family" scenario, consisting of two adults and children. (This was slightly higher than the national average of 40%, as reported in the 1986 Census of Canada). R-2000 homes appeared to be quite popular with young families (including childless couples). For interpretation purposes, it was assumed that a child was anyone under 18 years of age. A slightly lesser percentage of the homeowner sample consisted of adults without children. The "other" category in the graph represented situations where there were more than two adults at home or single parent families.

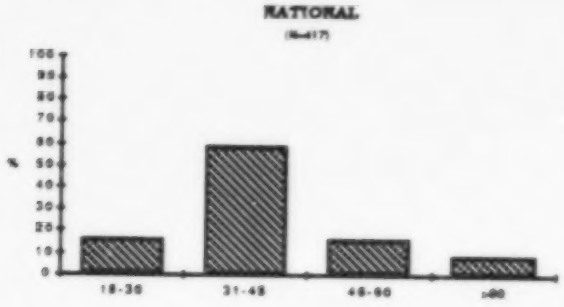

PHASE 2
COMPARISON OF NUMBER OF ADULTS WITH AND WITHOUT CHILDREN
OTHER (13%)
ONE ADULT, NO CHILDREN (3%)
TWO ADULTS, NO CHILDREN (35%)
TWO ADULTS, CHILDREN (47%)

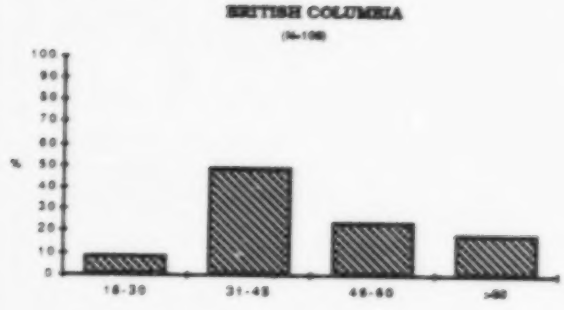
Occupations

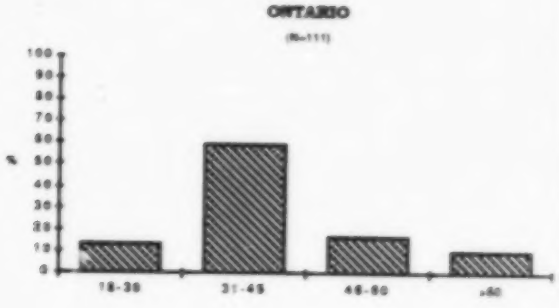
When the occupants were asked to define their occupation, the employment group with the highest response at the national level was the "professional" category. The management category was the second most popular. This appeared to be the trend for all regions except British Columbia where the highest percentage of occupants were from the "retired" category. The national and regional graphs documenting the occupations of the various respondents are presented on page 8. The occupations of their spouses are presented on a national and regional basis on page 9.

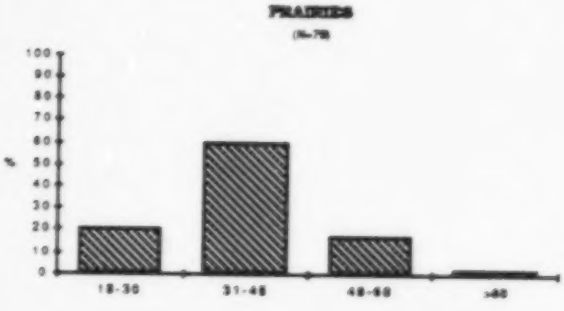
The number of income producers in the household was analyzed. Eleven per cent of the homes surveyed had occupants with no clearly definable wage earning category. Thirty two per cent had only one occupant in a wage earning category. The majority of the respondents (57%) reported double incomes. Six per cent of the houses reported that both occupants were employed in the professional category.

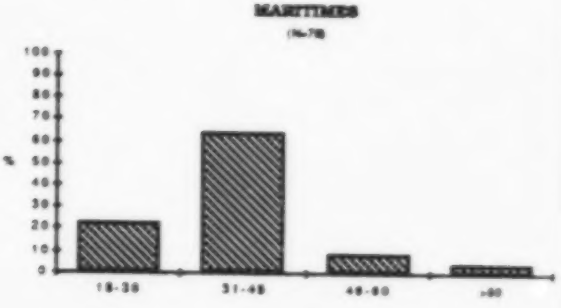
AGE OF OCCUPANT (Phase 2)

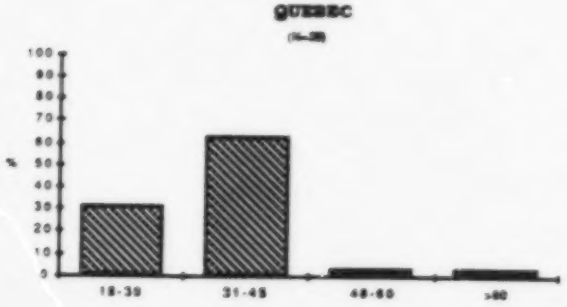


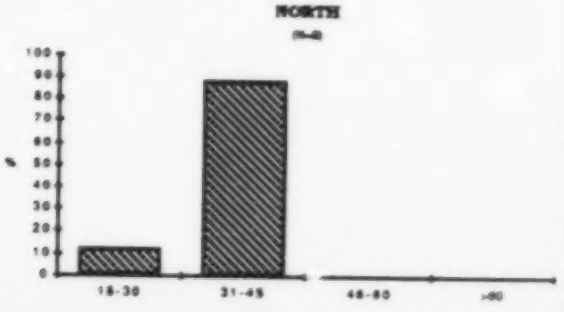




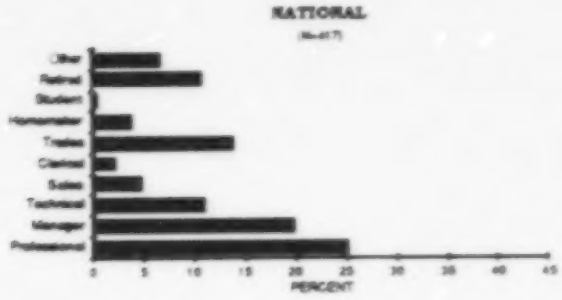


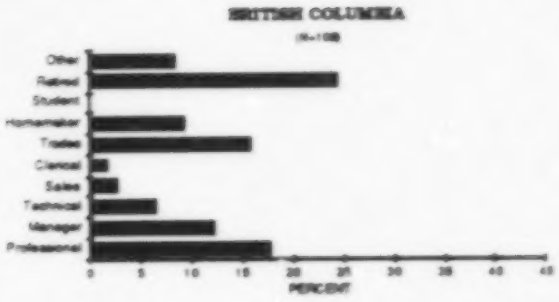


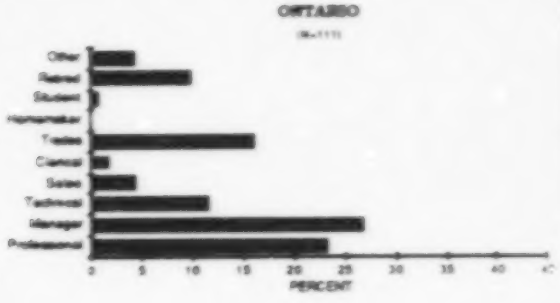


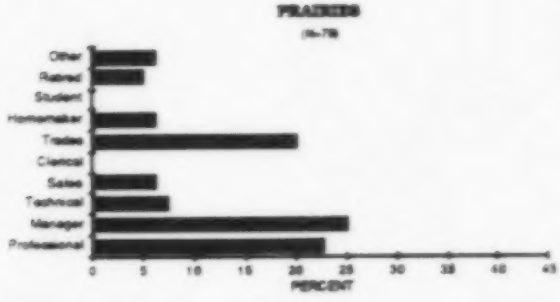


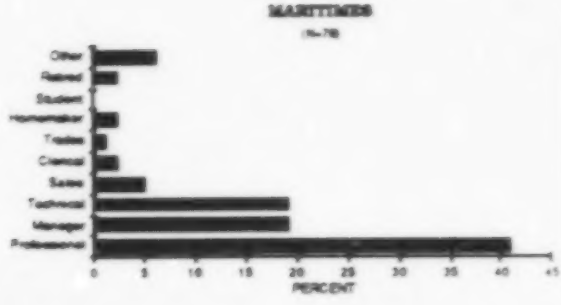
OCCUPATION OF OCCUPANT
(Phase 2)

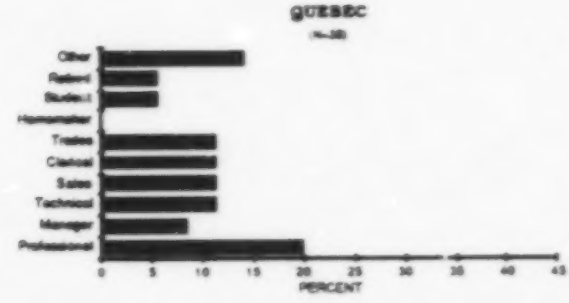




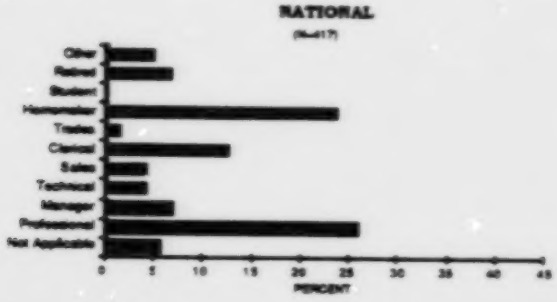


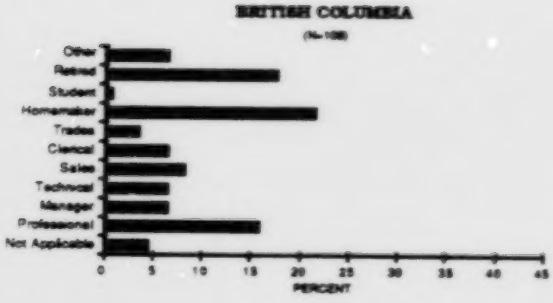


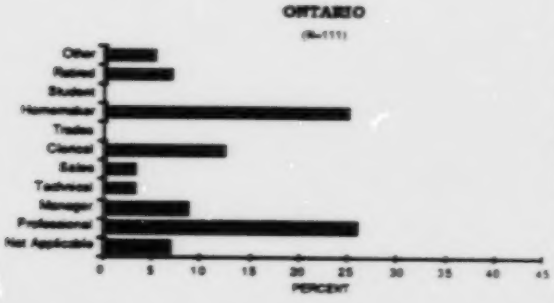


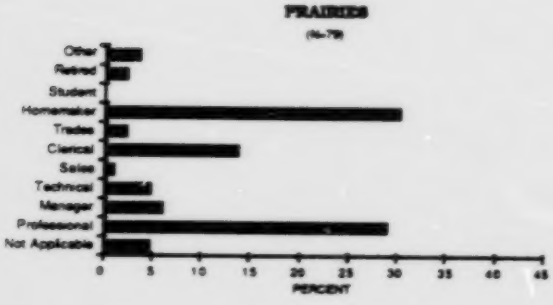


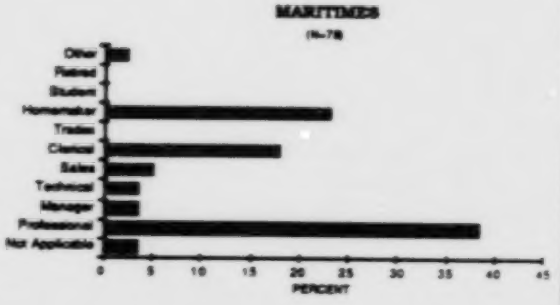
OCCUPATION OF SPOUSE
(Phase 2)

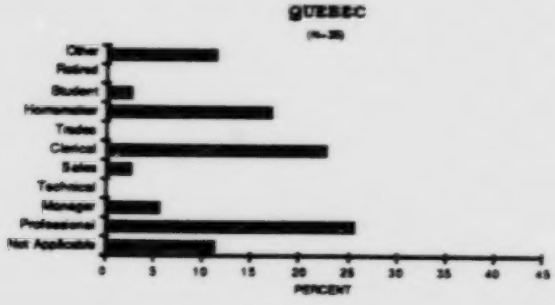






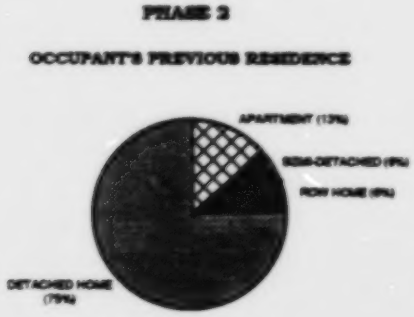


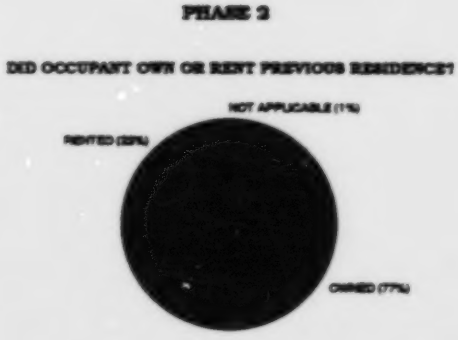




Previous Type of Residence

The typical R-2000 homeowner in the Phase 2 survey previously owned a detached home. Specifically, 75% of the occupants reported living in a detached home and 77% of the occupants owned their previous residence.





Awareness of Energy-Efficiency

A general awareness of energy-efficiency on the part of the homeowner indicated an interest in matters of energy conservation. The homeowner survey included questions concerning the homeowner's level of awareness of the Energuide rating of their appliances. More than half the homeowners were aware of the Energuide rating at the time of purchase and 32% of the homeowners considered the energy-efficiency of their appliance to be an important factor in their purchasing decision.

In summary, the typical R-2000 homeowner in the Phase 2 survey was young (approximately 80% were less than 45 years), held a professional or managerial position and usually had a working spouse. They were "move-up" buyers who owned their previous residence which, in most cases, was a detached home.

3.3 Factors Influencing Purchase Decision

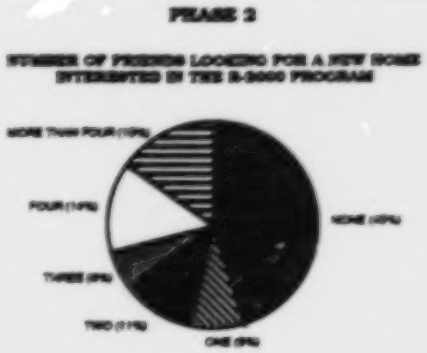
3.3.1 General Concerns

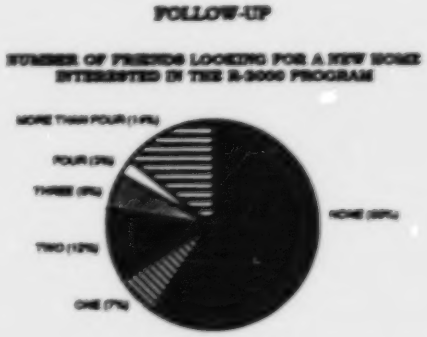
Many factors influence the home-buyer's decision to purchase an R-2000 Home. These include: financial considerations; the aesthetic appeal of the house and the reaction of the homeowner to the prospect of paying more for future gain in terms of a more energy-efficient house.

Information Sources

Through the homeowner survey, an attempt was made to determine the source of information which led the homeowner to the final purchase of an R-2000 Home (refer to graph page 12). In all regions, it appeared that the builder was the predominant source of information, followed by the government and print media. It should be noted that much of the latter source (print media) was government-funded.

R-2000 homeowners were a source of information for prospective home buyers. Slightly more than one-half of the homeowners reported that one or more of their friends became interested in the Program. This percentage decreased slightly when the same question was asked in the follow-up survey.

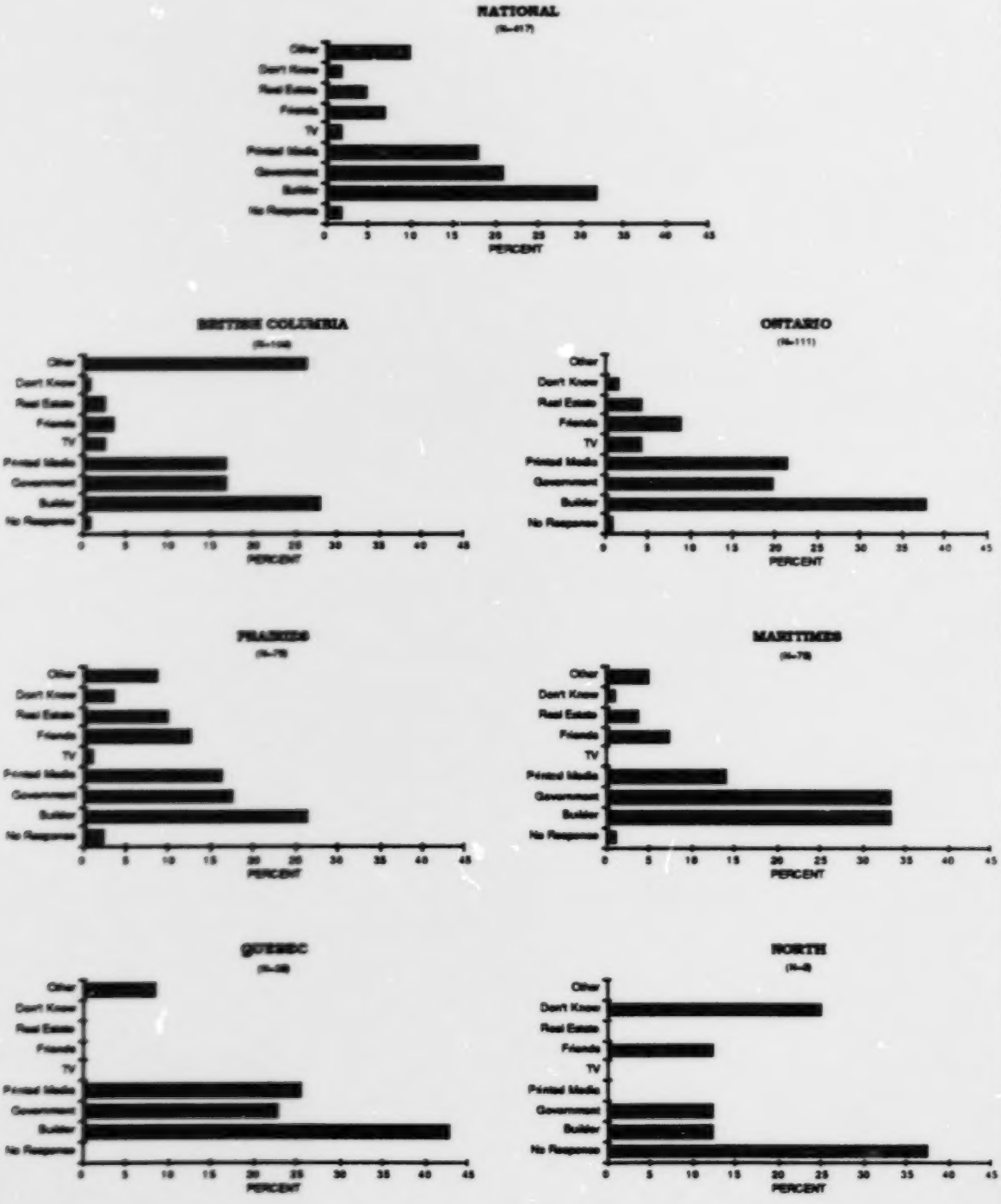




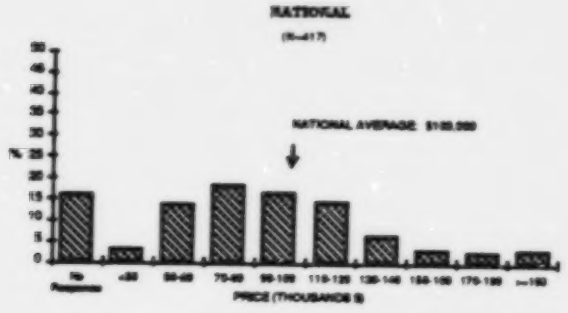
Building Costs

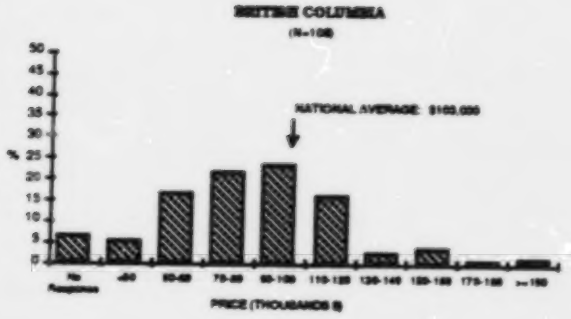
On page 13, graphs depicting the range of R-2000 house prices, excluding land costs, are presented by region. The majority of the houses cost between $50,000 and $129,000, with a national average of $103,000. Noticeable anomalies include Quebec which was significantly weighted below the national average, and Ontario which had a heavy weighting above the national average. The data from the Northern region must be considered in the context of its small sample size.

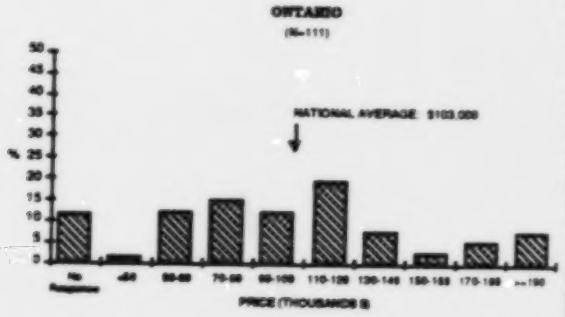
INFORMATION SOURCE (Phase 2)

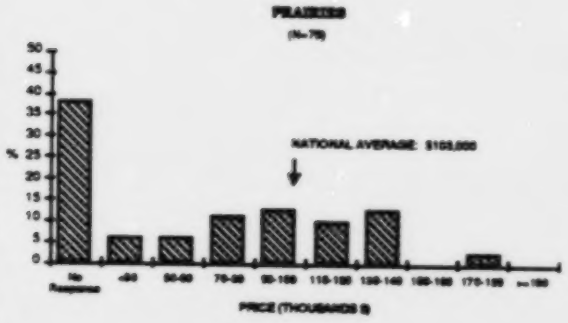


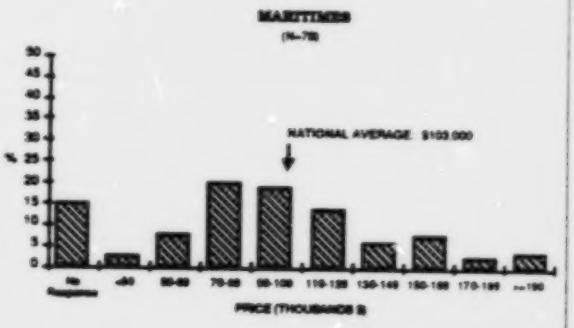
PRICE OF HOUSE IN PURCHASE YEAR
(excluding land costs) (Phase 2)

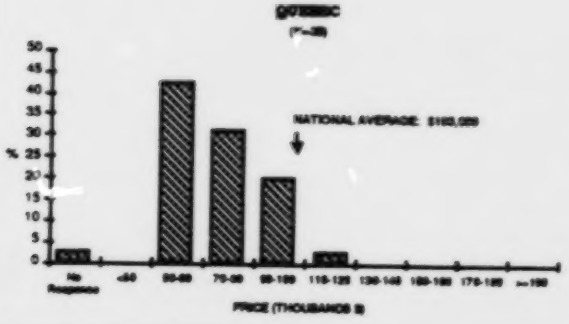


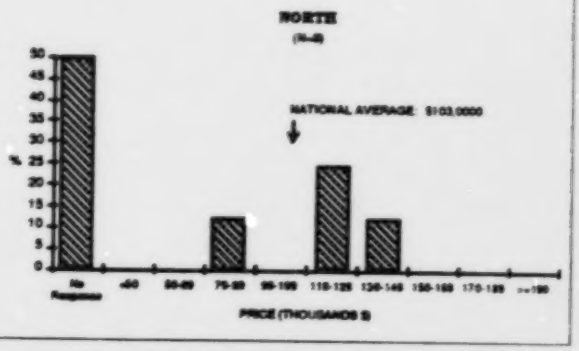












Custom Building

One potential advantage to the R-2000 home-buyer is their increased level of involvement in the design of their new home. In all regions, except for the North and Quebec, homeowners took advantage of this and, to some extent, customized their home.

PHASE 2

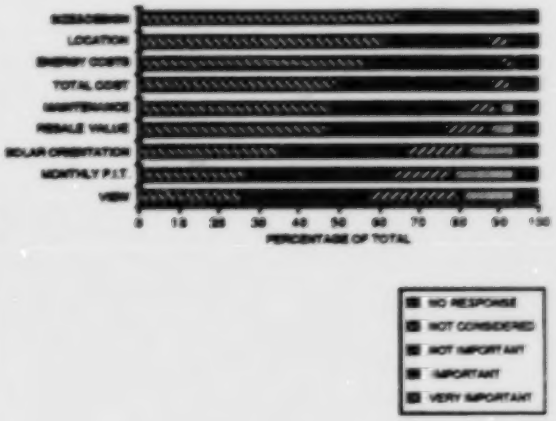
HOUSE BUILT AS A CUSTOM HOME: BY REGION

Ranking of Factors

In order to develop an overall picture of the features considered at the time of purchase, the homeowners were asked to rank nine factors in order of importance. The size and design of the house were found to be the most important considerations of the home-buyer. Cost ranked fourth out of the nine factors listed. It is significant that energy cost was one of the three most important factors and was ranked higher than the cost of the home.

PHASE 2

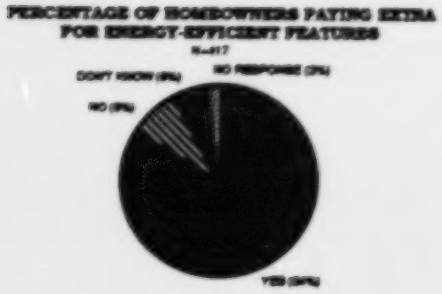
RELATIVE IMPORTANCE OF THE FOLLOWING FACTORS AT THE TIME OF PURCHASE



3.3.2 Energy Considerations

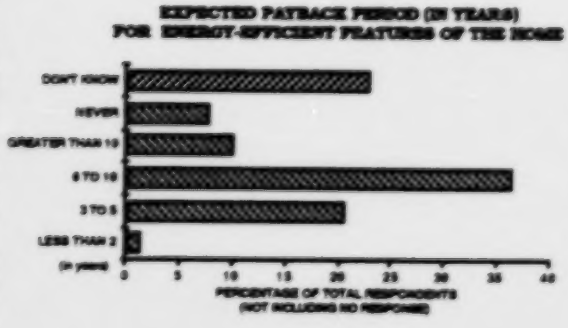
The energy-efficient features of the R-2000 Home appeared to be important characteristics. There was recognition that the extra initial cost was worth the long-term benefit. Twenty three per cent of the homeowners expected a payback period of 5 years or less.

PHASE 2



Twenty three per cent of the homeowners reported not knowing the length of their payback period. Possibly, the payback period was not an important purchasing consideration or the homeowner was unsure as to how to calculate this factor.

PHASE 2

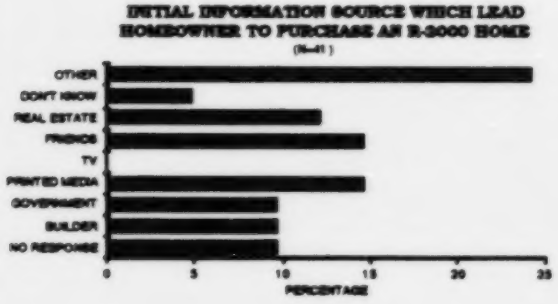


3.3.3 Resale Homes

Some differences were observed in the perceptions of home-buyers who had purchased a used R-2000 Home when compared with the perceptions of buyers of new R-2000 houses.

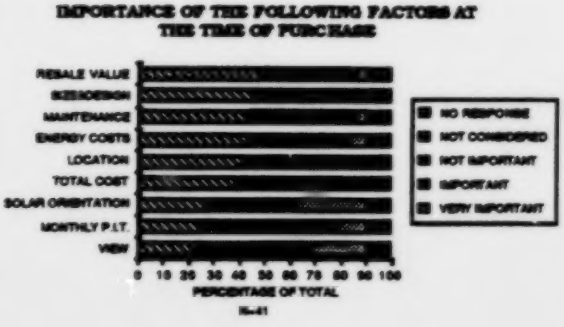
Information Sources

For home-buyers of used R-2000 homes, the principal source of information was no longer the builder.



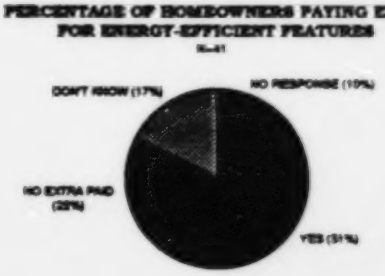
Ranking of Factors

To the homeowner, the most important factor at the time of purchase was resale value. Energy costs still ranked quite high in their importance.

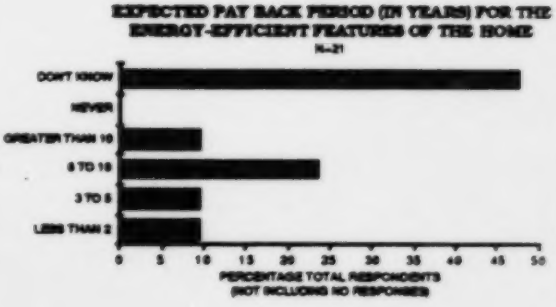


Energy Considerations

Fewer buyers of used R-2000 homes felt that they paid extra for energy features than the purchasers of new R-2000 homes. Of the new home-buyers, 84% reported paying a premium while only 51% of the homeowners purchasing used homes felt they had paid a premium.



Furthermore, most of the purchasers of used R-2000 homes did not know the amount of time it would take to pay back the extra purchase price. This may indicate a lack of interest in energy-efficiency or a lack of information.



3.4 Homeowner Perceptions After Living in an R-2000 Home

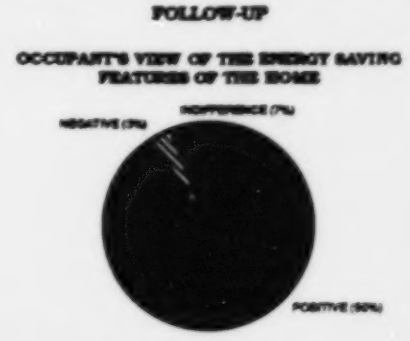
There were many questions in the original and follow-up surveys which provided homeowner impressions of the R-2000 Home after a period of occupancy. Insight was gained from examining such issues as energy consumption, indoor air quality, general comfort, noise and other factors. Responses to the follow-up survey and the changes in responses between the original and follow-up surveys were examined.

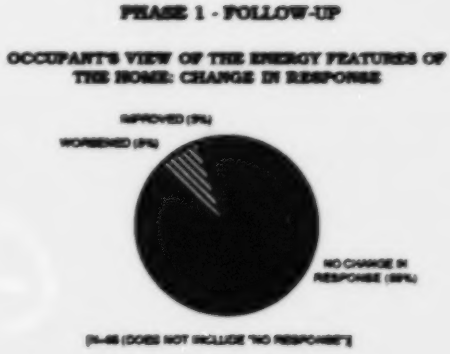
An indication of homeowner satisfaction was determined from the problems, or lack of problems, reported by the homeowner.

3.4.1 Energy Consumption

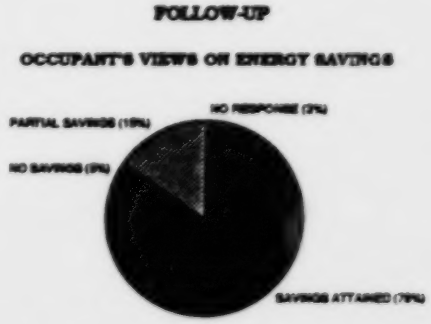
It was established earlier that energy cost was an important issue in the homeowner's decision to purchase an R-2000 Home. It would be informative to determine the homeowner's perception of these energy features after they have lived in the home for a period of time.

The follow-up survey asked the homeowners two questions concerning their view of the energy features. The first question asked how the occupant viewed the energy features of their homes. The vast majority of the homeowners (90%) viewed the energy features as a positive characteristic of the R-2000 Home. This was corroborated when the change in response between the Phase I homeowner survey and the follow-up survey was examined.




PHASE 1 - FOLLOW-UP
OCCUPANT'S VIEW OF THE ENERGY FEATURES OF THE HOME: CHANGE IN RESPONSE
IMPROVED (3%)
WORSENED (2%)
NO CHANGE IN RESPONSE (95%)
[N=40 (DOES NOT INCLUDE "NO RESPONSE")]

A second question asked whether the occupant felt energy savings were being attained. The majority (78%) of the homeowners felt that energy savings were attained, while only 5% believed that savings were *not* attained. It would appear that any concerns of energy cost-effectiveness were being satisfactorily met.



3.4.2 Non-Energy Issues: Perceived Advantages and Disadvantages

This subsection identifies some of the homeowner perceptions of living in an R-2000 Home (excluding the energy issues). Each graph presents the relative ranking of ten unique factors. It is worthwhile noting that, under the survey format used, these questions were unprompted. That is, the homeowner identified the issues; the issues were not suggested by the survey.

These questions were included in both the original and follow-up surveys. It could be inferred that the contents of the homeowner survey conducted shortly after the homeowner occupied the R-2000 house would be affected by purchase information or sales claims, whereas, the follow-up survey responses would reflect actual experiences.

Issues identified by the homeowner have been classified under four categories: Indoor Air Quality, Thermal Comfort, Noise and Other.

Perceived Advantages and Disadvantages to Living in an R-2000 Home

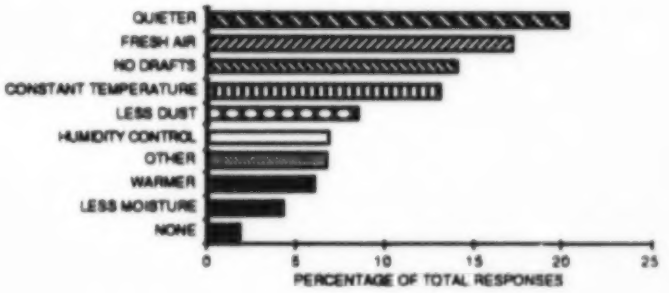
	Perceived Advantages	Perceived Disadvantages
Indoor Air Quality	• Less Dust • Less Moisture • Humidity Control • Fresh Air	• Air Too Dry • High Humidity • Stale Air
Thermal Comfort	• Warmer • No Drafts • Constant Temperature	• Overheating • Cold Basements
Noise	• Quieter	• HRV Noise • Loud Furnace
Other		• Electricity Costs

Advantages

According to the R-2000 homeowners questioned under the Phase 2 survey, the most important perceived advantage to living in an R-2000 Home was that the home was "quiet". (It was assumed that this referred to noise from outside the home). The second most important advantage, "fresh air", indicated the homeowners placed value on the R-2000 house ventilation system. In level of importance, the third and fourth advantages, "no drafts" and "constant temperature" respectively, indicated the importance of comfort to the homeowner.

PHASE 2

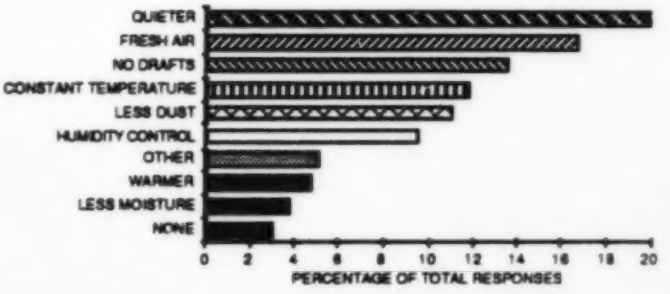
PERCEIVED ADVANTAGES TO LIVING IN AN R-2000 HOUSE (EXCLUDING ENERGY ISSUES)



Interestingly, the most important non-energy related factors identified by the homeowners were the same factors highlighted by proponents of R-2000 homes: thermal comfort, indoor air quality and reduced noise levels. It would be expected that, shortly after purchasing the home, homeowners would be particularly aware of these factors and would be sensitive to assessing these conditions.

FOLLOW-UP

PERCEIVED ADVANTAGES TO LIVING IN AN R-2000 HOUSE (EXCLUDING ENERGY ISSUES)



The follow-up survey results showed no change in the ranking of the perceived advantages and little change in the percentage response compared to the Phase 2 results. The homeowners' responses were the same as before, perhaps indicating the same personal bias of likes and dislikes or indicating that, after a longer period spent in the home, their initial "lived in" perception was unchanged.

Response Changes Between Original and Follow-up Surveys: Advantages

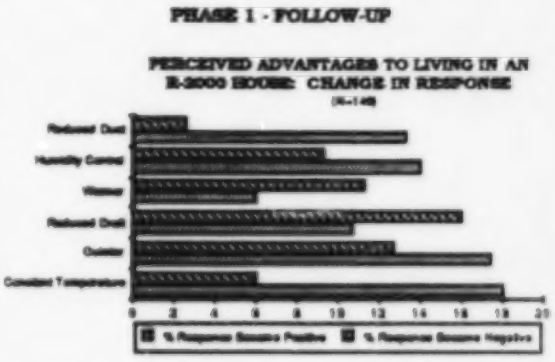
Change in Response graphs illustrate the way individual homeowners changed their minds concerning some of the issues.

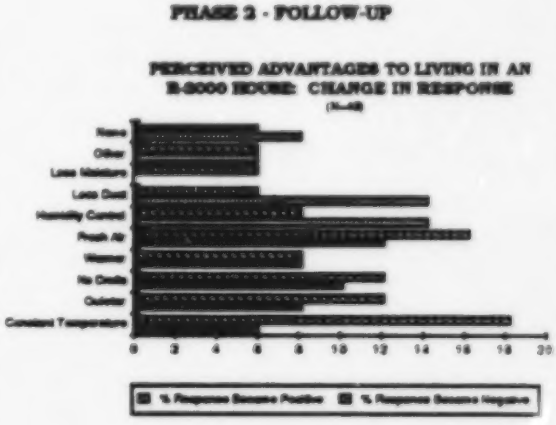
The majority of the Phase 1 and Phase 2 homeowners who changed their responses reported reduced dust and humidity control as an advantage rather than a disadvantage. The same observation was true for Phase 1 homeowners on the issues of quietness and temperature stability. For Phase 2 homeowners, however, the response was the reverse with regard to quietness and temperature stability.

A change in perception, from advantage to disadvantage, occurred with the issue of reduced drafts and, for the Phase 2 homeowners only, with the issues of less moisture and fresh air.

The net change for any given issue was usually less than 10%, which would indicate that the perceptions were largely unchanged. Furthermore, although some of the issues are related (such as less moisture and humidity control), the homeowner may not understand the relationship, and responses to related issues may be inconsistant with one another.

CHANGE IN RESPONSE



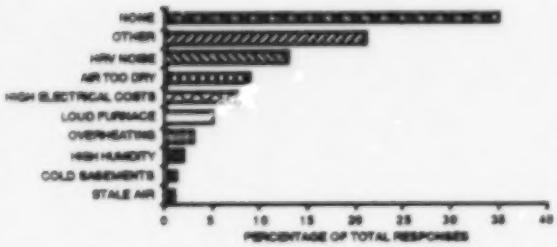


Disadvantages

When asked about the disadvantages of living in an R-2000 Home, the most common homeowner response was "none". The first definable problem, HRV noise, was ranked third out of the ten responses listed. Closely following the problem of HRV noise was the problem of "dry air". This problem could be related to the operation of the ventilation system (the house was "over ventilated", at least with respect to humidity).

PHASE 2

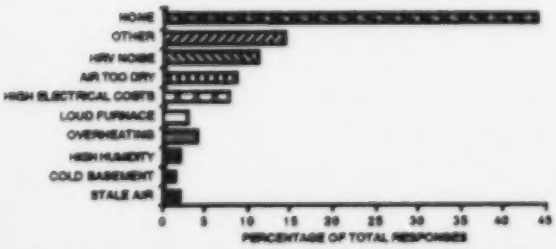
PERCEIVED DISADVANTAGES TO LIVING IN AN R-2000 HOUSE



There was no significant change between the results of the original homeowner survey and the follow-up homeowner survey. The most noticeable change was the increased percentage of homeowners who responded that there were no perceived disadvantages, indicating a more positive view of their R-2000 Home.

FOLLOW-UP

PERCEIVED DISADVANTAGES TO LIVING IN AN R-2000 HOUSE



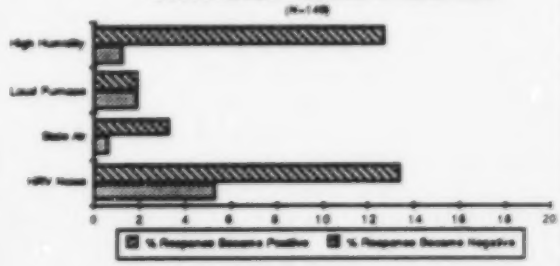
Response Changes Between Phases 1 and 2 and the Follow-up Surveys: Disadvantages

After occupying the house for at least one year, more homeowners found high humidity and HRV noise as a problem. The net change in response to these and the remaining issues was small (7%), indicating little change in perception. For example, of the homeowners who changed their response between the two surveys, 27% shifted from perceiving no disadvantages to living in an R-2000 house (the "none" category) to indicating there was a disadvantage in the follow-up survey; while 20% shifted from perceiving a disadvantage to indicating no disadvantages in the follow-up survey.

CHANGE IN RESPONSE

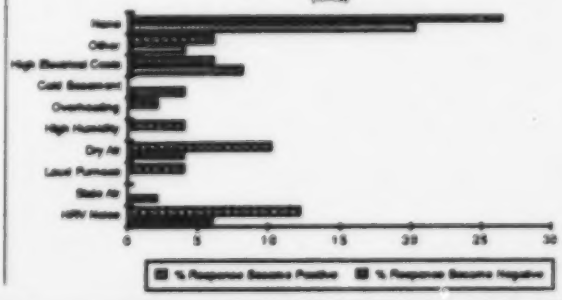
PHASE 1 - FOLLOW-UP

PERCEIVED ADVANTAGES TO LIVING IN AN R-2000 HOUSE: CHANGE IN RESPONSE



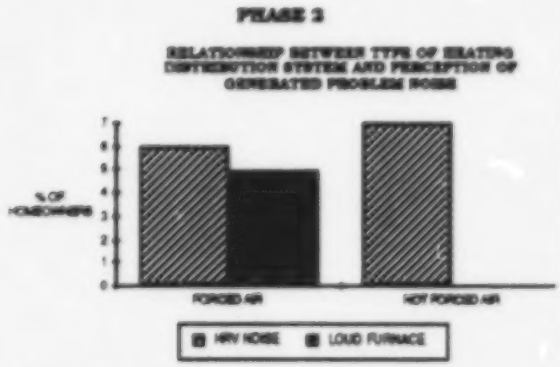
PHASE 2 - FOLLOW-UP

PERCEIVED DISADVANTAGES TO LIVING IN AN R-2000 HOUSE: CHANGE IN RESPONSE



3.4.3 Noise

Noise generated by the HRV and, where applicable, the forced air heating system were identified by Phase 2 survey homeowners as the major disadvantage of living in an R-2000 Home. It was hypothesized that a forced air heating system would have a moderating effect on the perception of noise.



In houses without a forced air distribution system, the sound generated by the HRV was an irritant to seven percent of the homeowners. In houses with a forced air system, the HRV and furnace contributed to a slightly reduced perception (1% and 2% respectively) of a noise problem.

3.4.4 Indoor Air Quality

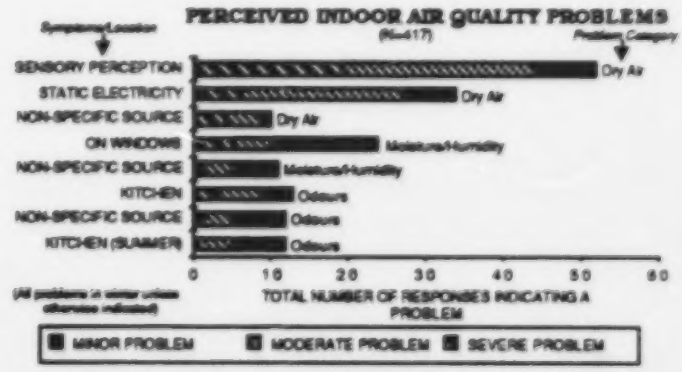
The occupants were asked to list any air quality problems in the house. The person conducting the survey did not prompt the homeowner, but simply recorded the homeowner's responses. Three different indoor air quality problem categories were identified: dry air; moisture and humidity problems; and odours. Seasonal variations were noted and a "severity" rating was attached to the response (minor, moderate, or severe).

The general response to these questions was quite low, and few homeowners indicated any problem.

The problem for which there were the greatest number of responses (50 homeowners, 12% of the sample) was the perceived sensation of dry air.

Seven of the eight problem areas identified occurred during the winter. It should be noted that there was no attempt to cross-correlate these problem types. A homeowner may have indicated more than one problem which will appear elsewhere in the graph.

PHASE 2



Dry Air and Other Air Quality Problems

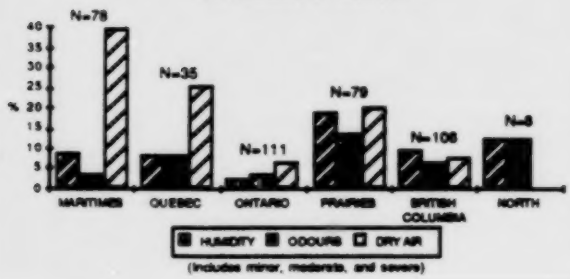
The sensory perception of dry air is common. This problem must be considered in conjunction with other factors such as: climatic conditions, occupant lifestyle (affecting indoor moisture generation rates) and the difficulty of defining the sensitivity of the homeowners to dry air.

Dry air problems may indicate a problem of over-ventilation. Moisture, humidity and odour problems were, typically, rated at minor severity. With such low response, these problems were probably more related to certain unique conditions in that house concerning ventilation rates and indoor generation of moisture and odours.

A regional breakdown of indoor air quality problems by major category reveals some variations in the perceived problem. The most obvious was the large response to "dry air" problems in the Maritimes. Over two thirds of the responses were from New Brunswick. Dry air was also the predominant problem reported in Quebec houses.

PHASE 2

PERCEIVED HUMIDITY, ODOUR, AND DRY AIR PROBLEMS BY REGION



There was a distinct contrast between the number of responses from Prairie homes versus Ontario homes for all problem types. It cannot be assumed that this is a direct reflection of regional building construction practice. A significant difference between these two regions is the type of climate which is experienced, particularly in winter.

These results can be clarified by answering the question "what type of conditions are people used to?" To homeowners in the Maritimes, where the climate is humid and high relative humidity is the "norm", dry air may be perceived as a problem at a higher average relative humidity than by a homeowner in the prairie region, where lower relative humidities are common.

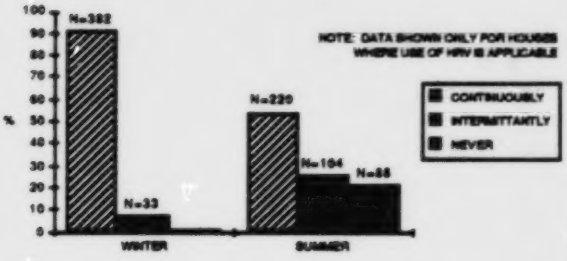
In conclusion, the perception of air quality is subject to many qualifications. However, given that 12% of the homeowners mentioned at least one problem in this area, there is an indication that the R-2000 Program must continue to ensure that good indoor air quality be maintained.

3.5 Homeowner Operation of the Air Distribution System

A heat recovery ventilating unit (HRV) is an important component of most R-2000 homes and it deserves special attention in determining its use. The winter heating season is the most important time of year for the proper use of the HRV. Ninety per cent of the homeowners ran their HRV continuously during that time. The remaining homeowners ran their HRV at least part-time during the winter. As well, 50% of the homeowners ran their HRV continuously during the summer.

PHASE 2

FREQUENCY OF OPERATION OF HRV

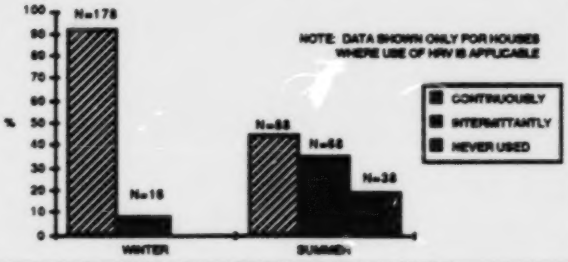


Two possible conclusions could be drawn from these observations: that the homeowner does not really see the HRV as an important component of the R-2000 house or may simply leave it on and forget about it. In the more likely scenario, the homeowner recognizes the HRV as an important part of the ventilation system and actively controls its use. It is interesting to note the relatively high degree of utilization of the HRV during the summer months -- a time of year when it would be expected that the windows of the house would be open and there would be a reduced requirement for ventilation by the HRV.

There was no noticeable change in the frequency of operation of the HRV in the follow-up homeowner survey, indicating that homeowners were consistent in their HRV operation.

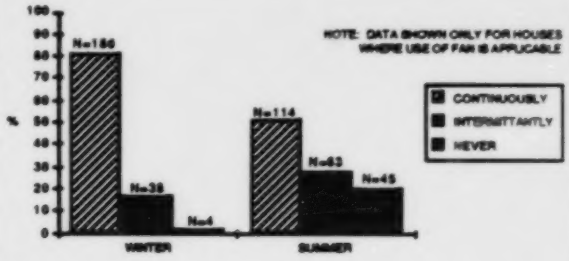
FOLLOW-UP

FREQUENCY OF OPERATION OF HRV



PHASE 2

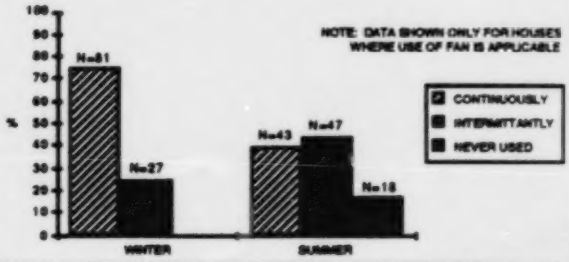
FREQUENCY OF OPERATION OF FURNACE FAN



The frequency use pattern of the furnace fan was similar to that of the HRV. Most homeowners were running their furnace fan on a continuous basis during the winter. There was no appreciable change in this pattern when the follow-up homeowner survey results were examined.

FOLLOW-UP

FREQUENCY OF OPERATION OF FURNACE FAN



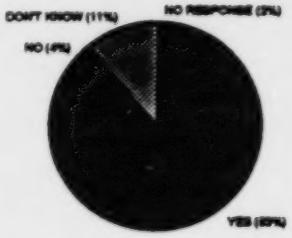
4.0 OVERALL SATISFACTION WITH THE HOME

R-2000 homes are sold as a quality product designed to satisfy the homeowner's desire for a wide range of features. After reviewing the responses made by the homeowner to specific questions in the survey, one question is still left to be answered: "Would you, the homeowner, buy such a house again?" In other words, after considering all the advantages and disadvantages, does the homeowner still like the product enough to make another similar purchase? The response to the first question is illustrated in the two pie charts on this page and serves as an excellent conclusion to the homeowner survey results.

The vast majority of homeowners would purchase another R-2000 Home, indicating a high overall level of satisfaction. Only 4% of the Phase 2 homeowners said they would not purchase again, while 11% did not know. This response showed no significant regional variation.

PHASE 2

WOULD HOMEOWNER PURCHASE ANOTHER R-2000 HOME



Homeowner Satisfaction in the Follow-up Survey

This question was also asked in the follow-up survey. The 84% positive response was not significantly different to that of the Phase 2 survey.

FOLLOW-UP

WOULD HOMEOWNER PURCHASE ANOTHER R-2000 HOME